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Reprinted from Transactions of the Thirty-Second North American Wildlife and Natural Resources Conference, March 13, 14, 15, 1967, Published by the Wildlife Management Institute, War Building, Washington, D. C. 20001

340 THIRTY-SECOND NORTH AMERICAN WILDLIFE CONFERENCE

BEHAVIOR OF FAMILY GROUPS OF CANADA GESE

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An intensive investigation into limiting factors and behavior of a wild population of Canada geese at the Seney National Wildlife Refuge in Michigan's Upper Peninsula was conducted from June, 1962, to August, 1965 (Sherwood, 1966 a). The purpose of this paper is to report the findings of that part of the study concerned with pair and family bonds of Canada geese and related management implications.

The Seney flock had its origin in 1936 when 332 pinioned Canada geese were donated to the refuge by Henry M. Wallace of Detroit (Johnson, 1947). All offspring of the pinioned flock were allowed to fly free, and they eventually established a migration and homing tradition. Hanson (1965) has identified these birds as giant Canada geese (*Branta canadensis maxima*).

During the course of the study, the size of the flock fluctuated between 800 and 1200. Annual production to flight stage ranged from 100 to 490.

THE STUDY AREA

Seney is part of the Great Manistique Swamp. Halladay (1965:2) described the area as follows:

The region is characterized by vast expanses of lowlands consisting of a black spruce bog condition interspersed with patches of sedge glade and strips of high ground which support white, red and jack pine. . . . The soil and subsoil throughout this region is pure, medium sand. Only a few inches of the surface layer have weathered and contain organic matter. Accumulations of peat and muck have formed throughout most of the bog and wet areas.

The 95,535-acre refuge is composed of four broad habitat types of which 416 acres are cropland, 26,911 acres upland (brush and timber), 60,265 acres marshland, and 7,243 acres open water. Twenty-one pools, in which water levels can be controlled, contain most of the open-water acreage. The pools range in size from 27 to over 1,000 acres. They contain numerous islands which are used by the geese for nesting purposes.

METHODS

Much of the study required rapid and accurate identification of individual geese. Flexible plastic collars were developed for this purpose (Sherwood, 1966 b). The collars, bearing letter-numeral combinations, were placed on 468 geese, including all or parts of 81

family groups. The findings presented in this paper are based on observations of some of the marked geese.

RESULTS

Pair Bonds and Family Relationships

To show clearly the various facets of pair and family bond relationships, the histories of several family groups are traced. The many letter-numeral combinations can be confusing to the reader, but such designations are essential for accurate identification and interpretation. In the following histories, abbreviations used include AM for adult male, AF for adult female, LM for local (gosling) male, and LF for local (gosling) female. In a few cases, two birds carried the same letter-numeral combination; but the collars used in 1963 were orange, those in 1964 were white.

T5 and P2—1963. T5 (AM) and P2 (AF) were trapped and marked with their goslings D1 (LF), D3 (LF), B5 (LM), and A7 (LF) on June 27, 1963 on the Lower Show Pool. P2 and one gosling (D1) were run over by a vehicle on M-77 on August 26, 1963. B5 was not seen after that date and was presumed killed with the other two. The gander (T5) raised the remaining two goslings, and the little brood was observed numerous times until their departure shortly after November 24, 1963 (Figure 1).

O6 and K5—1963. O6 (AM), K5 (AF), K7 (LF), M7 (LM), and M8 (LM) were marked as a complete brood unit on July 20, 1963 on F-1 Pool. The group was last noted November 18, 1963. The adult male, O6, and gosling, M9, were later shot on the Tennessee-Kentucky Lake impoundment near Camden, Tennessee on January 5 and 13, 1964, respectively (Figure 1).

T5 and K5—1964. Sometime between January 5 (when K5's mate, O6, was shot) and March 15, T5 and K5 formed a new pair bond as they returned to Sency on the latter date with the remnants of the two broods (D3, A7, and K7) (Figure 1).

T5 and K5 successfully hatched a brood of four on May 17, 1964, and raised three to flight stage. The new brood was trapped on July 15, 1964, and white collars K2, K8, and J6 were placed on the three.

The three survivors of the two 1963 broods (D3, A7, and K7) were frequently observed near T5 and K5's nesting island while K5 was incubating the 1964 clutch. The three yearlings remained more or less together throughout the summer, yet never rejoined the parent birds and new brood until, possibly, just prior to migration when A7 was noted with the group on November 13, 1964.

T5 was observed on the Tennessee National Wildlife Refuge on December 23, 1964, but was apparently shot shortly after because he

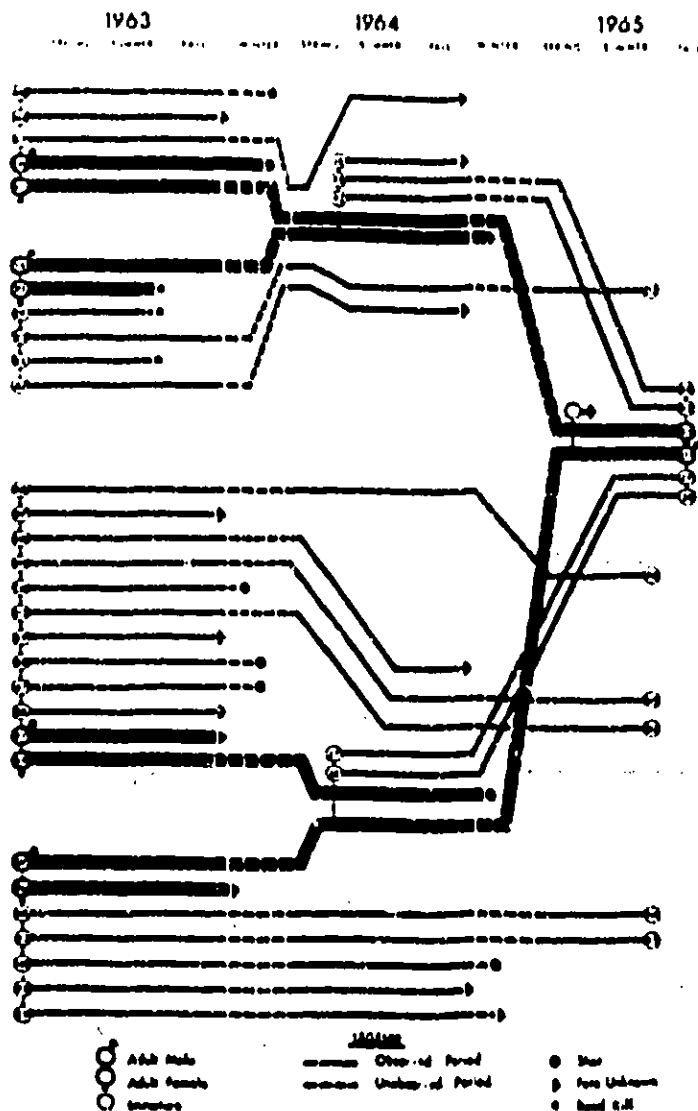


FIGURE 1. Pairing, inter-relationships, and mortality of family groups of Canada geese, Sney National Wildlife Refuge, 1963-1965.

failed to return to Seney in the spring of 1965. The same fate presumably befell A7 and K7 (1963 goslings)—although K7 was also sighted on the Tennessee Refuge on December 23—and J6 (1964 gosling) as they, too, failed to return in 1965.

K5 did return to Seney in 1965 and again established a new pair bond—this time with O7 (Figure 1). Two 1964 goslings (K2 and K8) also survived to return. So did the last survivor (D3) of the two little 1963 broods. D3 in 1965 was a 2-year-old. She mated and successfully brought off a brood of five on May 25, 1965.

O7 and K6—1963. O7 (AM) and K6 (AF) with their brood of five—N1 (LM), N5 (LM), E9 (LM), K3 (LF), and K8 (LF)—were marked on July 20, 1963 on F-1 Pool (Figure 1). They remained intact and were last noted on the refuge in 1963 on November 26. On December 9, 1963, the family group was spotted by Conservation Officer David Pyers on the Mesick Sanctuary in Lower Michigan about 150 miles south of Seney.

K8 and K3 returned to Seney on March 23, 1964, followed by O7, N6, and N1 on March 25. E9 was noted on the 26th. O7's mate, K6, did not return and was presumed shot.

T7 and K9—1963. T7 (AM) and K9 (AF) with their large, permanently mixed brood were marked on June 30, 1963 near headquarters (Figure 1). Goslings marked included B6, B7, B8, B9—males, and D2, D4, D5, D6, D7, A6—females. The brood was noted frequently through the summer and fall and departed shortly after November 20, 1963.

Apparently, the family was nearly decimated during the hunting season. D4 was shot on Hamlin Lake in Mason County, Michigan on December 13, 1963. (The hunter wrote that he didn't notice the orange neckcollar until he picked the goose up). B8 and B7 were shot at the Sardis Game Reserve near Oxford, Mississippi on December 30, 1963 and January 2, 1964, respectively. T7, the adult male, B6, B9, and D7 never returned to Seney in 1964 and were presumed shot, also. However, D2, D5, D6, and A6 did return with the goose, K9, on April 7, 1964.

O7 and K9—1964. O7 was unmated in the spring of 1964 (his 1963 mate, K6, had failed to return). He was involved in an extended battle of several minutes duration with another large gander on March 27 and was soundly beaten. It was apparent that he had lost status as a result and was frequently threatened, chased, and pecked by other geese for the following 12 days.

O7 was still unmated as late as the morning of April 8 as he was observed being harassed by other geese. However, the day before, K9 had returned to Seney without her 1963 mate, T7. Amazingly, O7 and

K9 established a pair bond by noon on April 8 (Figure 1), and by evening, O7 was exhibiting the typical pair behavior including threats, head bobbing, neck weaving, and the entire greeting ceremony ritual.

Equally amazing was the speed at which the new pair carried out the reproductive process. They nested on F-1 Pool where K9 incubated a clutch of six eggs. Five of the eggs hatched on or about May 20, as the pair was observed with their new brood on May 21. Back-dating 30 days for incubation and nine days for laying revealed that K9 started to lay on or about April 11, just three days after the pair bond was formed. O7 and K9 successfully raised two of the goslings (J4 and J7) to flight in spite of a severe gosling die-off.

Following the molt in 1964, three of K9's 1963 goslings (D2, D5, and D6) rejoined her, O7, and the new brood. D2 did not remain as closely tied to the group as the other two yearlings. A6 did not rejoin the brood and was observed several times exhibiting pairing tendencies with an unmarked bird. Of interest was the fact that none of O7's five returning 1963 goslings (K8, K3, N5, N1, and E9) rejoined the new family in 1964. N1 and N5 had dispersed to some unknown point through most of late spring and summer; E9 was observed on numerous occasions exhibiting strong pairing tendencies with an unmarked goose; and K3 and K8, the two females, were usually noted together through the summer. Yet, in late fall, the yearling brood of five had regrouped and was observed on November 19, 1964, just prior to migration.

Spring 1965 saw the return of O7 and his two 1964 goslings, J4 and J7, on April 8, but he had again lost his mate. She had been shot near Big Sandy, Tennessee on January 10, 1965. Of the two-year-old group (1963 goslings), N1 and K3 returned in 1965, N5 was shot near Newton, Mississippi on December 24, 1964, and E9 and K8 failed to return and were presumed lost (Figure 1). E9 had been observed on the Tennessee National Wildlife Refuge on January 22, 1965.

O7 and K5—1965. Thus it was that O7 and K5 were mates in 1965. Each had two separate mates the previous two years but had lost them; O7 with K6 in 1963 and K9 in 1964—K5 with O6 in 1963 and T5 in 1964 (Figure 1). These birds all frequented the same areas and were "acquainted" with one another. This was probably the reason for O7's swift pairing with K9 in 1964.

O7 and K5 apparently came back together on April 8, 1965. On April 9, O7 was rejecting and chasing his 1964 brood, J4 and J7, from the nesting island. K5 proceeded to lay three eggs, hatched only one, and it was shortly absorbed into one of the larger broods. Consequently, O7 and K5 went into the 1965 molt without any goslings, but they

were joined by J4 and J7 (O7's 1964 goslings) and by K2 and K8 (K5's 1964 goslings).

O5 and O8—1963-1965. The family history of O5 (AM) and O8 (AF) was less complicated because the pair survived the three years of the study (Figure 2). O5, fondly called "Old Eyebrows" because of white spotting above his eyes, was marked on July 20, 1963 with his mate, O8, and their seven goslings, N2, N3, N4, M9—males and K1, K2, K4—females. The family group was last noted in 1963 on November 24.

N3 was later shot on the St. Joseph River near Elkhart, Indiana. N2 and K2 were assumed dead because they failed to show up at Seney in 1964. N4, M9, K1, and K4 returned as a group to Seney on March 30, 1964—three days after their parents, O5 and O8, arrived. Shortly after, N4 and M9 (males) dispersed to unknown points, but K1 and K4 (females) remained in the area.

O5 and O8 were successful in raising a mixed brood of eight to flight stage in 1964. There was by far the largest brood on the refuge following the gosling die-off. The new brood, marked on July 15, 1964, included K3, K6, T3, T8, T9, L8, L7—females and J8, the only male.

Following the molt, yearlings N4, K1, and K4 rejoined the parents and new brood, M9 did not return to the group and was not observed again.

O5 was the dominant bird in the F-1, I-1, J-1, and headquarters areas of the refuge in 1964. He and his 12-member family group (mate, 8 goslings, and 3 yearlings) were noted almost daily until late fall. The goslings, even when nearly full grown, took advantage of their parents' status in the flock as they often chased other older geese. Any bird that attempted to retaliate was immediately headed off by one or both of the parents, chased and occasionally, briefly "thrashed." N4, the yearling male, was learning his role well from the "patriarch," and it was apparent that he was developing into a dominant bird, too. That offspring assume the social rank of the parents when they remain in the brood was previously pointed out by Hanson (1953). In 1964, the big family was last observed on November 25.

The group wintered on the Tennessee National Wildlife Refuge as reports were received of observations of O8, L7, and L8. Somewhere along the line, however, the big family unit ran into trouble. N4 was shot near Olney, Illinois on December 5, 1964. No other band recoveries were reported but only the parents, L8 and J8 (1964 goslings) and K1 (1963 gosling) returned to Seney in the spring of 1965. Further evidence of what the family had encountered was

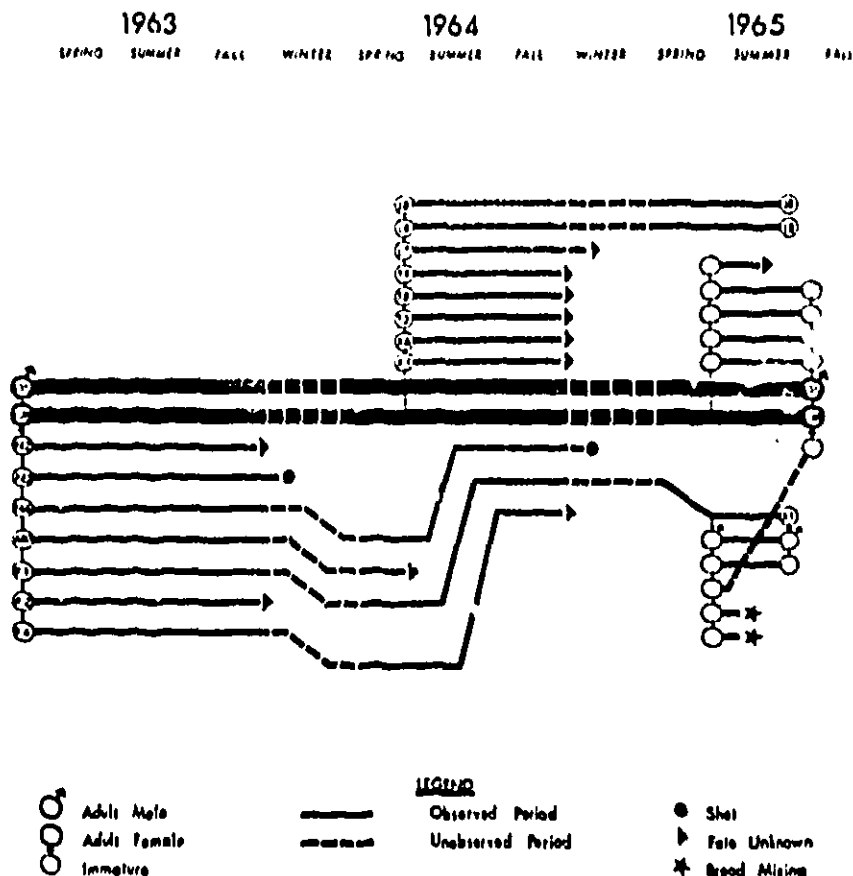


FIGURE 2. Family relationships and behavior of O5 and O8, a marked pair of Canada geese, Brury National Wildlife Refuge, 1963-1965.

revealed when it was noted that O5's collar had a perfect shot hole through it.

K1, the 2-year-old female and only known survivor of the 1963 brood of seven, mated and successfully hatched a brood of four on May 28 (Figure 2). Within a few days she had lost three to more dominant groups but raised the other to flight. K1 and her little family were allowed complete freedom with "Old Eyebrows" and his brood. Wherever the parent brood went, K1's group was right behind. It was a case with human attributes—the young daughter learning the role of brood raising from the long experienced old folks.

Although "Old Eyebrows" and O8 lost a gosling, they picked up another about a week younger—it may have been one of K1's—and successfully raised the five to flight in 1965.

A 1966 sequel to this family history was received from Refuge Manager John B. Hakala (personal communication, June 13, 1966). O5 and O8 survived the hunting season to return to Seney in the spring of 1966. The pair hatched a brood of six goslings about mid-May and the family group was observed almost daily until May 25. On June 8, the old female, O8, was missing from the group. She was never seen again and "Old Eyebrows" raised the brood alone.

Then, in early September, according to Orlynn J. Halladay, Assistant Refuge Manager (personal communication, October 28, 1966) and Gerald H. Updike, Refuge Biologist (personal communication, February 14, 1967), O5 and his nearly-grown brood were joined by K5 and her one remaining offspring (she had only hatched two in 1966). K5's mate O7 had disappeared several days prior to this new union between O5 and K5.

T1 and P1—1963-1965. The history of T1 (AM) and P1 (AF) was different. They were marked on June 21, 1963 along with their mixed brood, A1, A2, A3, A4—females and H1, H2, H3, H4, H5, H6, H7—males (Figure 3). There was some loss in the brood and A2, A4, H1, and H7 were not observed after August 1. The other nine, however, remained together and were last noted below the E-C Spillway on December 6, 1963.

On April 10, 1964, six of the seven 1963 goslings were observed back at Seney. Only H6 failed to return. The parent birds, T1 and P1, did not show up until May 3. Apparently, they had attempted to nest but their efforts had been thwarted by predation. They then lingered for several days within the territory of T5 and K5. Shortly after, they were rejoined by five of their six remaining 1963 goslings—A1, A3, H2, H4, and H5. Only H3 did not join the group. At the time he was involved in a pairing tendency with another goose. The family group then molted and remained most of the summer and fall on Tee Lake in Blaney Park, ten miles to the south of the refuge. They returned at infrequent intervals to feed on the refuge.

In 1965, T1 and P1 returned to Seney on April 9. So far as could be determined, A1, A3, H2, and H4 returned with them. H3 and H5 failed to show up. Of the four 2-year-olds that returned, both H2 and H4 (males) established pair bonds with two unmarked geese. Apparently no successful nesting occurred, however. A1 (female) did not pair, but A3 (female) did and successfully hatched five goslings in late May, all of which were taken into larger broods by June 16.

T1 and P1 hatched five goslings on May 23, 1965. Through brood

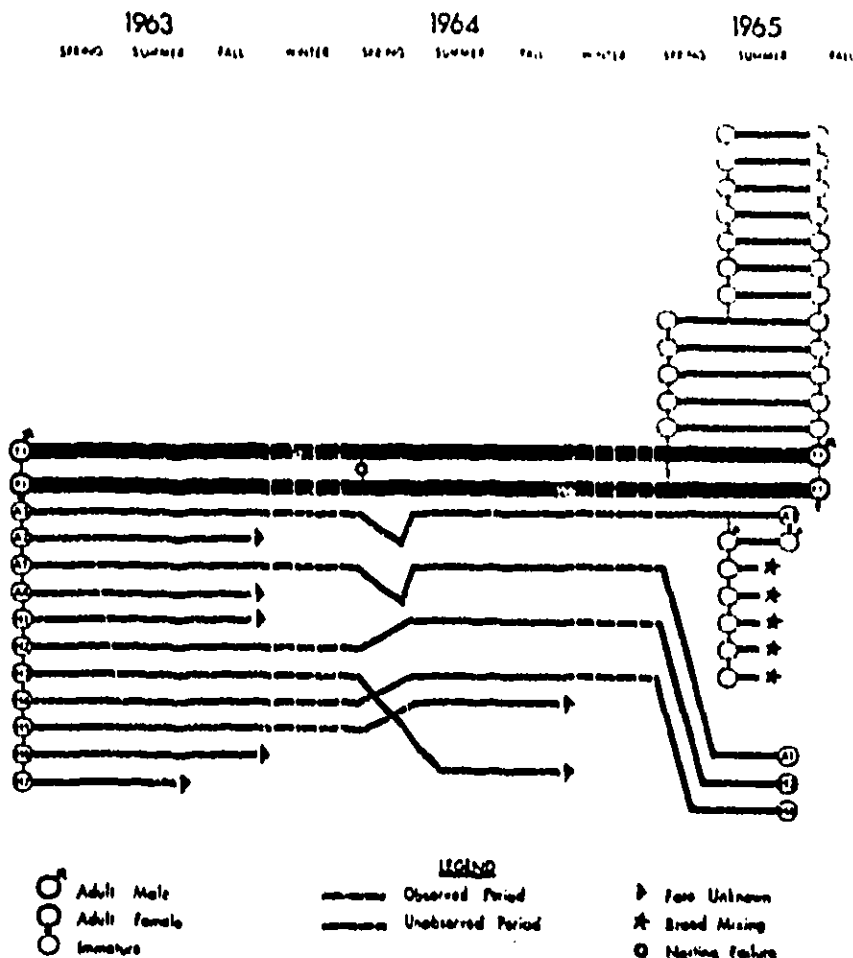


FIGURE 3. Family relationships and behavior of T1 and P1, a marked pair of Canada geese, Seney National Wildlife Refuge, 1963-1965.

mixing they held as many as 36 goslings and brought 12 to flight in a permanent family group. There was evidence that some of the additional goslings belonged to the 2-year-old, A3 (Figure 3).

L2 and Mate—1955-1965. During the study, additional information was added to an unusual account of pair bond strength in a pair of Seney geese.

The story was revealed on August 27, 1962, when student assistant James Goldsberry trapped a family group of five geese in a walk-in

trap on F-1 Pool. The parents had previously been banded. A check of the refuge banding files showed that the female (508-22116) and male (508-22117) were banded together and in sequence on July 22, 1955. They were listed as adults at that time.

In November of 1955, the male was again trapped at Seney and shipped by truck with 99 other geese to Lacassine National Wildlife Refuge in Louisiana for a transplanting experiment. The displaced geese were hard hit by hunters (14 direct returns), but the male survived. It was not known when or where the two adults were again united as they were not retrapped until 1962.

The pair was not trapped in 1963, but their three 1962 goslings returned and were trapped. They were marked with orange collars U2 (male), P3 and R3 (females) on July 3. The three remained together up to the last observation on November 23. U2 and P3 were obviously still together on December 24, 1963 when R. J. Crank of Paris, Tennessee shot them both near Tennessee-Kentucky Lake in Henry County, Tennessee. They were 20 months old at the time. R3 was not seen again and was presumably shot, too.

The old pair returned to Seney in 1964 and brought off a brood of undetermined size. Apparently brood mixing or the 1964 die-off claimed most of their brood as they succeeded in raising only one gosling to flight. The old female was caught on July 15, and white collar 2 was placed on her. The little brood was last observed on November 20, 1964. The gander was never difficult to identify because he carried two Fish and Wildlife Service bands—one regular and the additional one as a result of the Lacassine experiment.

It wasn't until May 25, 1965 that the old pair was seen with a brood of five on the south Show Pool dike. With their return in 1965, the pair had been together 11 years and were at least 13 years old. Age appeared to have little to do with seniority or flock dominance as the gander had a subordinate role in the flock.

Their luck in raising the 1965 brood was little better than their 1964 effort. Two of the goslings were missing by June 18 and a third one shortly after. The other two were brought to flight in early August.

T1 and L3 (white)—1961-1965. In September of 1961, it seemed clear that a pair bond had developed between T1, a seven-year-old male, and L3, an immature female about 17 months old. They desired solitude from the flock and were often seen alone in a small, quiet pool along the nature trail.

The two returned to Seney on April 4, 1965, well ahead of most of the flock. T1 apparently had to persist considerably to bring L3 into receptive breeding condition because her brood of three (from clutch

of four) did not hatch on H-1 Pool until June 6, a week after the peak hatch of the flock.

There was not a dominant role in the flock, but they lost none of the goslings because of mixing.

On June 16, L3 began acting strangely and was observed separated some 200 yards from the brood. She was back with the brood briefly on June 17 but disappeared completely on June 18 when the goslings were just two weeks old. L3 was later found dead in the grass along the east dike of Upper P-1 Pool on June 24 by a work crew.

After L3 disappeared, T1 took charge of the brood alone and raised two goslings to flight. He even picked up two additional goslings for a short time in late June.

DISCUSSION

A number of significant facts emerged from the histories just presented and from observations of other marked families not detailed herein. They are as follows:

Pair Bonds

Evidence indicated that productive and permanent pair bonds could be developed in a matter of hours in older, experienced, and "acquainted" geese. Klopman (1962:125) suspected this to some degree when he wrote that,

Pair formation, at least in the Canada Goose, usually appears spread over a period of months and may be vitally affected by early associations established in family groups and combined broods and flocks of sexually immature birds that form during the breeding season. One presumes, nevertheless, that the process of pair formation may be accelerated when pairs lose their mates early in the hunting season.

Pair bonds once established, were permanent so long as both members remained alive. There was no evidence of polygamy or promiscuity among the reproductively mature geese, nor was there evidence of pairing between brood mates.

Actual pairing and/or the origin of it took place on the nesting grounds. Some mate selection took place on the wintering grounds, as a result of hunting mortality, but the selection was based on previous experience or acquaintanceship on the nesting grounds.

Upon the death of a goose, ganders were capable of raising the brood alone and did so in three known cases.

Yearling Activity

The yearlings frequently returned to Seney in the spring with their surviving parents and brood mates. They attempted to follow the parents when they were establishing a nesting territory but were

shortly forced out of the family group by repeated rebuffs from the parents. About one day was ordinarily required to convince the yearlings they were no longer wanted.

After being rebuffed, instead of trying to follow the parent birds, the yearlings attempted, in some cases, to duplicate parental pair activities. Some of the pairing occurred between yearlings that had associated through brood contact the previous year.

There was an obvious tendency for the male yearlings to disperse from their natal areas but for the females to remain there. Apparently, this factor carried over as 2-year-old females invariably nested or reared their young in the same areas they frequented as goslings. The male dispersal was probably an expression of a pairing urge—to find an eligible female and establish the beginnings of a pair bond.

The ardor of pair bonds in most yearlings started to wane after about five or six weeks, or about the time most of the new broods had hatched and just prior to the molt.

There was clear evidence of yearlings rejoining their parents just before the molt, when the parents had lost their nest or brood (T1 and P1 in 1964 and O7 and K5 in 1965). Also, many yearlings, both male and female, rejoined their successful parents and new broods following the molt. The parents were not willing to have the yearlings rejoin until the new brood was on the wing.

Yearling brood-mates retained strong family ties well into the second year, with or without the presence of the parent birds.

Two-Year-Old Females

Martin (1964) found that 33 percent of the 2-year-old females nested in Utah. Craighead and Stockstad (1964), working in Montana, indicated that between 27 and 36 percent of the 2-year-olds nested in the Flathead Valley flock. Both investigators were working with *Branta canadensis moffitti*. Brakhaug (1965) also found that 33 percent of the *Branta canadensis marino* 2-year-olds nested in the Trimble flock in Missouri. But, Hanson and Smith (1950), working with *Branta canadensis interior*, suspected that 2-year-old females were productive. Finally, Hanson (1962) stated that, "At the present state of our knowledge, predictions of wild populations must be based on the assumption that all females attempt to nest at approximately 2 years of age or in their third spring of life."

At Seney, of 16 female goslings banded in 1962, at least six returned in the spring of 1964 (three others were shot and one other previously found dead). Breeding data on five of the six were obtained. Of the five, four nested. Thus, from the very limited data available in 1964, about 80 percent of the 2-year-olds nested at Seney.

In 1965, data from 11 two-year-old females were obtained. Eight of

the 11 nested for a 73 percent reproductive effort among the 2-year-old females. Of the three that did not nest, two paired with yearling males and the third remained solitary. While 11 birds cannot be considered a large sample, it still constituted about 10 percent of the 2-year-old females, thus making the results meaningful. From the data obtained, it was concluded that about 75 percent of the 2-year-old females nested at Seney in 1964 and 1965.

Six of the eight nesting attempts were successful. Average brood size at hatching for the six successful broods in 1965 was 4.4 which compared favorably with a 4.4 average brood size for the entire hatch. Calculations based on flock structure showed that the 2-year-old females contributed 25 to 33 percent of the hatch (about 200 of 676 goslings hatched in 1965). The fact that many of the 2-year-olds lost their broods to older, more experienced and dominant pairs did not detract from their contribution.

Nest locations and/or brood rearing areas for the parents of six of the successful 2-year-old nesters were known. In every case, the 2-year-olds nested and/or raised their broods in the same general area that they were hatched or reared themselves. There was evidence that some of the 2-year-old females lost, or willingly gave-up, their own goslings (brood mixing) to their parents. The tendency for the 2-year-old females to nest in their natal areas undoubtedly encouraged this type of brood mixing when the old parents were still living.

MANAGEMENT IMPLICATIONS

Measurements of Productivity

Lynch and Singleton (1964) have developed a method to determine annual productivity in blue, snow, and white-fronted geese by counts of families and other "functional groupings" on the wintering grounds. The method is considered reliable because of distinctive first winter coloration of the young of these geese.

Elder and Elder (1949) and Hanson and Smith (1950) suggested that average group counts of Canada geese in the fall would indicate numbers of family groups and this in turn could be used to determine annual productivity. Lebreton (1956) took issue with these methods, pointing out that small groups of geese may not necessarily be identical to families, that only true family counts should be used and that such true family counts are not possible in Canada geese because the young are not readily distinguished from adults.

Lynch and Singleton (1964) have attempted to modify their methods of determining productivity in blues, snows, and white-fronts for use with Canadas. In the modified method, small groups of Canada geese of 10 birds or less are recorded and an average taken

which is converted to a percent to indicate the degree of productivity (Lynch, 1962). Hanson (1965) indicated that this method is less reliable than trapping samples in the fall or aerial photographic surveys on the breeding grounds.

Evidence from this study indicates that individual groups of geese migrating from Seney may be composed of: (1) a true family group with both parents and original young; (2) a true family group with both parents, original young, and one or more yearlings from the previous year's brood; (3) a true family group with both parents, *without* any young-of-the-year (nesting or brood loss) but with one or more yearlings from the previous year's brood; (4) a family group in which brood mixing has occurred which results in families of greater than 10 members on one extreme and in pairs without any young on the other—these groups may or may not include yearlings from the previous year's brood; (5) any of the foregoing groups with one parent missing; (6) a union of two families where one parent of each has died or been killed; (7) yearling siblings; (8) pairs without young (nesting or brood loss) or pre-mating pairs.

Other than Number 1, all the combinations represent a potential source of bias in determining productivity in Canada geese by family counts in the fall. Some of the potential biases were recognized by Elder and Elder (1949) and Lynch (1962) in developing their methods. However, it is the writer's opinion that such biases cannot be overcome by "average group counts."

The findings at Seney may not be typical of major populations of Canada nesting in the North. On the other hand, it is not known with certainty that these factors do not exist in more northern nesting populations.

SUMMARY

Behavior relative to pair bonds and family relationships in a wild population of Canada geese (*Branta canadensis maxima*) were studied at the Seney National Wildlife Refuge in Michigan's Upper Peninsula from June 1962 to August 1965. Numbered plastic collars were placed on 468 geese, largely family groups. Findings were based on observations of geese so marked.

It was found that; (1) a productive pair bond could be developed in a matter of hours in older, acquainted geese; (2) pair bonds were permanent so long as both members remained alive; (3) pairing took place on the nesting grounds; (4) ganders raised the brood alone following death of the goose; (5) yearlings frequently returned to the nesting grounds with their parents; (6) yearlings often rejoined their parents after the nesting season; (7) brood mates retained strong ties

well into the second year; (8) about 75 percent of the two-year-old females nested and contributed about 33 percent of the hatch; (9) 2-year-old females attempted to nest close to their natal home; and (10) brood mixing occurred and 2-year-old females were most vulnerable in losing their goslings to older, aggressive pairs.

Family groups of Canada geese contained from two to 21 members. The composition of such groups was influenced by mortality, brood mixing, yearlings rejoining parents and unions of two families. These assemblages represent a potential source of bias in determining productivity in Canada geese by fall counts of family groups. Such biases cannot be overcome by "average group count" methods currently in use.

ACKNOWLEDGMENTS

Many individuals were instrumental in contributing to the success of this investigation. Without their help the study could hardly have been initiated and certainly never completed. I am gratefully indebted to them all. In particular, I should like to acknowledge Harvey K. Nelson, Forrest A. Carpenter, John B. Hakala, Vandiver L. Childs, and Dr. Joseph H. Low, Bureau of Sport Fisheries and Wildlife; Dr. Allen W. Stokes, Utah State University; and my wife, JoAnn.

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DISCUSSION

HARVEY PAYNTER (Saskatchewan, Canada): This was a most interesting paper. It wasn't until the end that you came to the adoption method of making up a family group. Up in Regina, we have a waterfowl park where we produce around 500 goslings a year, and it is not unusual to see one pair with 20 to 45 young. The adults are sitting around and letting others baby-sit. I've wondered if mortality isn't greater when you have such a large number of goslings with just one pair, and if you have seen more cases of adoptions that weren't necessarily from the original family group?

DR. SHOREWOOD: Yes, this could take place. In fact, this mixing phenomenon was common and did not necessarily take place between the older birds and their own young from previous years. The largest group we had was a group of 21 that just one pair took care of. And for all intents and purposes as soon as this family bond was sealed then those 21 and the parents became a family group that stayed together until late fall and left together.

FROM THE FLOOR: Did your study include observations on parenthood and balanced family groups? If so, did you notice any impact upon the survival that was caused by the dominant pair?

DR. SHOREWOOD: There definitely was dominance established between various family groups. There seemed to be some evidence, however, that the most dominant birds were the most successful in raising young. They were also the ones that gathered the additional goslings from the other birds.
